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ABSTRACT

Teacher participation in a research project was examined to determine the effectiveness of an individualized mathematics program involving drill and practice in computation processes. The first data set was gathered from a laboratory school (experimental group) where the teachers were accustomed to trying out new programs, and a private school (control group) which already had a strong "basics" program. The experimental group was exposed to the new program, while the control group continued the standard program for an eight-month period. Post-tests of students revealed no significant difference between the groups on mean gain scores. The second set of data was gathered within the same time frame as the first, but with teachers who were not convinced they had a satisfactory program for instruction in basic arithmetic. A significant mean gain in scores was apparent in the schools which used the new intensive drill program. Findings suggested that, where a strong conventional program does not exist, the new experimental program can produce significant results. The study is claimed as a classical example of applied research in the classroom with teachers acting as researchers. (JD)

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COLLABORATIVE RESEARCH AS A MEANS OF DISSEMINATING MODELS TO IMPROVE LEARNING

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The meager influence of educational research upon classroom teaching has been a matter of serious concern to educators for many years. Gagné (1978) and Tyler (1978) have agreed that the outcomes of research appear to have "no more than a small direct influence on school practices" (Gagné, 1980). One might infer that the fact that teachers rarely read research type articles contributes to the theory-practice gap. When Reys and Yeager (1974) asked teachers why they avoided research articles, 80% gave one of two reasons as their first or second choice. They cited lack of direct classroom application and a lack of time as their reasons for not reading educational research. Interestingly, Cogan and Anderson (1977) reported that teachers appear to read significantly more often those articles which give pragmatic ideas that can be implemented in the classroom. It would appear that research that is responsive to the practical needs of teachers as well as to the theoretical needs of researchers will have a better chance of being implemented. Begle and Gibb (1980) argue for the inclusion of teachers in the research process. They are hopeful that such an inclusion might shorten the time lag between development and practice which has been estimated to be as great as fifty years!

But, realistically, how does the elementary or secondary classroom teacher who carries a full time teaching load find time to conduct effective research on a continuing basis? Furthermore, most teachers do not have strong research orientations. Reys and Yeager (1974) reported that teachers included statistical jargon, excess of charts, graphs, and tables, and inaccessibility of journals as reasons for not reading research-flavored articles. Our position is that a collaborative research effort is one practical approach to narrowing the theory--practice gap in education.

This project included twelve teachers from four different schools, an administrator, and a university professor as members of the collaborative

research team. The participants, as will become evident, had their own reasons for becoming involved. We will also discuss how the project has affected classroom practice.

THE SNAP PROJECT

The SNAP program was developed at the University of Pittsburgh at the Learning Research and Development Center in 1978. An individualized basic facts program was needed to complement an individualized mathematics program which was being used. The individualized mathematics program (Individually Prescribed Instruction) was succeeding in many ways. Children progressed through the program at their own rates. Curriculum embedded tests assured understanding before children proceeded to more complex concepts. Achievement on standardized tests was generally good. However, as children progressed to working with larger numbers that required regrouping, many of them slowed down. Observations by the classroom teachers revealed that although the children were understanding the mathematical procedures involved, they had not committed many of the basic facts to memory. Their responses were not automatic.

To address the difficulty, the classroom teachers developed an individualized mathematics program that involved drill and practice on the facts for the four processes: addition, subtraction, multiplication and division. Three minute time limits were imposed. The goal was to help the children to make rapid computations or to respond in a "snap". Six program components evolved. They included at-home-study sheets, administration of daily tests, daily practice sessions in school, use of manipulative materials for practice sessions, teaching thinking strategies, and the awarding of SNAP dragons as reinforcements for successful performance. As many of the children developed automaticity in the basic facts, the teachers became satisfied that their

program was a useful one. At this point, a question was raised. "Objectively, how do we know that this mechanism is effective?" It was a problem to be studied.

HISTORICAL BACKGROUND

Teachers in elementary schools have long realized that children must learn the basic arithmetic facts if they are to master algorathms for computation. The "Back to Basics" movement is in part testimony to the failure of many children to achieve such mastery. Mathematics educators have studied the problem for many years (Brownell, 1935; Rathmell, 1978; Thornton, 1978, 1983). Conflicting philosophies competed with the proponents of drill arguing for repetition (Cifarelli and Wheatley, 1979) and those favoring meaning theory arguing for teaching effective strategies (Thornton, 1978; Rathmell, 1979; Steffe, 1979).

Much has been written concerning a method or methods for teaching the facts. Data-based instruction (Dews, 1982) and imagery (Willott, 1982) are but a few examples from dissertations of variables tested to determine their effect on children's learning of basic facts. Journals such as the Arithmetic Teacher contain many articles describing strategies that the writers have found to be successful.

Brownell (1956) maintained that a proper balance between meaning and skill was essential and he proposed the following:

1. Accord to competence in computation its rightful place among the outcomes to be achieved through arithmetic.
2. Continue to teach essential arithmetic meanings, but make sure that these meanings are just that and that they contribute as they should to greater computational skill.

3. Base instruction on as complete data as are reasonably possible concerning the status of children as they progress toward meaningful habitation.

4. Hold repetitive practice to a minimum until this ultimate stage has been achieved; then provide it in sufficient amount to assure real mastery of skills, real competence in computing accurately, quickly, and confidently (p. 136).

While he addressed the problem of competence in computation skills in general, his guidelines are appropriate for a specific area such as the basic facts.

Thornton (1978) and Rathmell (1978) proposed a program based on thinking strategies to facilitate the learning of basic facts. They cited their own research and that of others as proof of the effectiveness of such a program. A later replication of Thornton's study by Cook and Dossey (1982) supported this conclusion. Carnine and Stein (1981) worked with addition facts to emphasize the need to make relationships such as the fact families (6+1=7, 6+2=8, and 6+3=9) explicit since all children do not develop these intuitively.

FIRST DATA SET

The first attempt to study the effectiveness of the SNAP program was coordinated by the authors and classroom teachers from two schools. School A, which would house an experimental group, was the campus laboratory school at the University of Pittsburgh. These teachers were used to trying out new programs and were smypathetic to the researchers' goals. School B, which housed the control group, was a private school located about five miles away. These teachers were convinced that they already had in place a very strong basics facts program for their second and third graders. They were, however, interested in seeing how their program would compare with the SNAP model.

A. Statement of the Problem

Will second and third grade children who use the SNAP program show a greater increase from pretesting to posttesting in basic fact acquisition and overall computation skills than children in a strong conventional basic facts program?

B. Hypothesis

There will be no significant difference in the gain scores between the SNAP group and the control group.

C. Procedures

Pretests were administered to 18 second graders and 21 third graders in the experimental group and to 18 second graders and 12 third graders in the control group. The experimental group was exposed to the SNAP program and the control group continued their standard program for an eight month period. Post tests were administered to all groups.

D. Analysis of the Data

A two tailed t-test was employed to compare the mean gain scores of the experimental and control groups. When disparate variancies occured, a separate estimate T value was used to interpret the data.

TABLE I

Comparison of Mean Gain Scores Between Experimental and Control Groups

GROUP	n	MEAN GAIN	STANDARD DEVIATION	STANDARD ERROR	T-VALUE
Experimental (SNAP)	39	15.38	11.12	1.781	
Control	30	15.83	7.69	1.404	-0.20

No significant difference existed between the two groups on the mean gain scores.

SECOND DATA SET

The second set of data was gathered within the same time frame as the first, however, the experimental and control groups were identified in a different way. The teachers who participated in the data collection for these groups were from the campus laboratory school at Indiana University of Pennsylvania and from a suburban public school system in the greater Pittsburgh metropolital area. In both situations, the teachers were not convinced that they had a satisfactory program in place for developing automaticity in the basic arithmetic facts. They were interested in exploring the potential of the SNAP program. The configuration of experimental and control classes were as follows:

	School A	School B
Grade 2	CONTROL	EXPERIMENTAL
Grade 3	EXPERIMENTAL	CONTROL

A. Statement of the Problem

Will second and third grade children who use the SNAP program show more of an increase from pretesting to posttesting in basic fact acquisition and overall computation skills than children in a conventional mathematics program.

B. Hypothesis

There will be no significant differences between the gain scores of the control groups and the gain scores of the experimental groups.

C. Procedures

Pretests and posttests were administered to 21 second graders from a suburban public school and to 21 third graders from a campus laboratory school. These classes comprised the experimental groups. Pretests and posttests were also administered to 21 third graders from a suburban

public school and 18 second graders from a campus laboratory school who made up the control groups.

D. Analysis of the Data

Two tailed t-tests were employed to compare the mean gain scores of the experimental groups with the mean gain scores of the control groups. When variances were not disparate, T-values for pooled variance estimates were used to interpret the data. If disparate variances occurred, T-values for separate variances were used.

TABLE II

Comparison of Mean Gain Scores between Experimental and Control Groups in a Campus Laboratory School

GROUP	n	MEAN GAIN	STANDARD DEVIATION	STANDARD ERROR	T-VALUE
Experimental SNAP	21	31.48	4.52	0.987	
Control	18	12.39	7.28	1.715	-9.64**

**Significant at .001

TABLE III

Comparison of Mean Gain Scores Between Experimental and Control Groups in A Suburban Public School

GROUP	n	MEAN GAIN	STANDARD DEVIATION	STANDARD ERROR	T-VALUE
Experimental SNAP	21	15.95	3.74	0.815	
Control	21	3.90	8.35	1.823	6.03**

FINDINGS

Perhaps the most intriguing finding revealed by the data is that the significant differences between experimental and control groups were found

within schools rather than between schools. The first data analysis suggests that it makes no difference wnether a school initiates a new comprehensive test and study program for basic facts acquisition or whether it has a strong conventional program in place as long as a consistent implementation of the program exists. On the other hand, where a strong conventional program is not in place, a mechanism such as the SNAP program can produce significant results.

DISCUSSION

Three of the four schools that participated in the study are now using the SNAP program on a regular basis. The school that has not adopted SNAP is the private school in Data Set I. The decision to adopt or not adopt the program make perfectly good sense in light of the results of the research. The school that did not adopt the SNAP program obviously didn't need it. The other schools teachers who participated in the study appear to have made judgments that are supported by the research findings.

This study is a classic example of applied research. Gagné says that this is precisely "the kind of research that teachers tend to originate, because its practicality is immediately evident" (1980). Clearly, the authors employed something less than an ideal design model. More important to us, however, was the collaboration of the participants at each stage of the research. One thing is certain, it didn't take fifty years for these teachers to make a SNAP decision!

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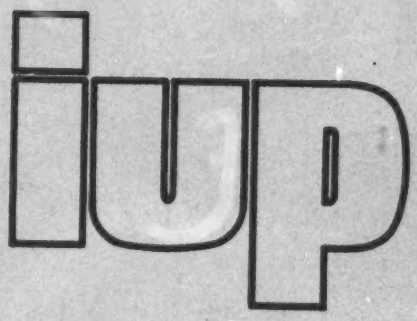

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